Gunter, Jason

From: Nations, Mark [mnations@doerun.com]
Sent: Thursday, September 12, 2013 10:13 PM
To: Gunter, Jason
Cc: England, Jason; Yingling, Mark; Wohl, Matthew; robert.hinkson@dnr.mo.gov; Ty Morris (TMorris@barr.com)
Subject: Leadwood Progress report
Attachments: LW 08-13.doc; 2013-08-21 LW NPDES Pace Lab Report.pdf

Jason,
Attached is the August progress report.
Mark

THE DOE RUN COMPANY

Remediation Group

Mark Nations
Mining Properties Manager
mnations@doerun.com

September 10, 2013

Mr. Jason Gunter
Remedial Project Manager
U.S. Environmental Protection Agency
Region 7 - Superfund Branch
11201 Renner Blvd.
Lenexa, KS 66219

Re: The Doe Run Company - Leadwood Mine Tailings Site Monthly Progress Report

Dear Mr. Gunter:

As required by Article VI, Section 50 of the Unilateral Administrative Order (Docket No. CERCLA-07-2006-0272) for the referenced project and on behalf of The Doe Run Company, the progress report for the period August 1, 2013 through August 31, 2013 is enclosed. If you have any questions or comments, please call me at 573-518-0800.

Sincerely,

Mark Nations
Mining Properties Manager

Enclosures
c: Jason England – TDRC
Mark Yingling – TDRC (electronic only)
Matt Wohl – TDRC (electronic only)
Robert Hinkson – MDNR
Ty Morris – Barr Engineering

Leadwood Mine Tailings Site
Leadwood, Missouri
Removal Action - Monthly Progress Report
Period: August 1, 2013 – August 31, 2013

1. **Actions Performed or Completed This Period:**
   a. Barr and Doe Run staff completed an inspection on the decant tower and concrete culvert associated with Leadwood Dam to assess its integrity and to verify that the structure can be utilized long-term for water management at the site.
2. **Data and Results Received This Period:**
   a. During this period, water samples were collected from downstream of Leadwood Dam and the East Seep and Erosion Area, as well as from upstream and downstream of the confluence of Eaton Creek with Big River. The analytical results for this event are included with this progress report.
   b. During this period, the Ambient Air Monitoring Report for May 2013 was completed. Any issues identified in this report are discussed below. A copy of this document has been sent to your attention.

      The May 2013 Ambient Air Monitoring Report noted the following:

      - The action levels for lead and dust were not exceeded.
      - No samples were taken with the TSP monitors on 05/27/13 due to the holiday.
      - No samples were taken with the PM_{10} monitors on 05/28/13 due to the holiday.
3. **Scheduled Activities not Completed This Period:**
   a. None.
4. **Planned Activities for Next Period:**
   a. Continue vegetation maintenance activities. The use of biosolids will only be continued if a biosolids management plan has been submitted to and approved by EPA.
   b. Complete monthly water sampling activities as described in the Removal Action Work Plan.
   c. Complete air monitoring activities as described in the Removal Action Work Plan.
5. **Changes in Personnel:**
   a. None.
6. **Issues or Problems Arising This Period:**
   a. None.
7. **Resolution of Issues or Problems Arising This Period:**
   a. None.

End of Monthly Progress Report

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

August 29, 2013

Amy Sanders
The Doe Run Company
P. O. Box 500
Viburnum, MO 65566

RE: Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Dear Amy Sanders:
Enclosed are the analytical results for sample(s) received by the laboratory on August 22, 2013. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jamie Church

jamie.church@pacelabs.com
Project Manager

Enclosures

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CERTIFICATIONS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Kansas Certification IDs
9608 Loiret Boulevard, Lenexa, KS 66219
WY STR Certification #: 2456.01
Arkansas Certification #: 13-012-0
Illinois Certification #: 003097
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212008A
Oklahoma Certification #: 9205/9935
Texas Certification #: T104704407-13-4
Utah Certification #: KS000212013-3
Illinois Certification #: 003097

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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SAMPLE SUMMARY

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60151522001	**LEADWOOD 001**	Water	08/21/13 09:53	08/22/13 08:30
60151522002	**LEADWOOD 002**	Water	08/21/13 10:04	08/22/13 08:30
60151522003	**LEADWOOD UPSTREAM**	Water	08/21/13 09:40	08/22/13 08:30
60151522004	**LEADWOOD DOWNSTREAM**	Water	08/21/13 09:24	08/22/13 08:30

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SAMPLE ANALYTE COUNT

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60151522001	**LEADWOOD 001**	EPA 200.7	JGP	3	PASI-K
		SM 2540D	LEM	1	PASI-K
		SM 2540F	LEM	1	PASI-K
		EPA 300.0	OL	1	PASI-K
60151522002	**LEADWOOD 002**	EPA 200.7	JGP	3	PASI-K
		SM 2540D	LEM	1	PASI-K
		SM 2540F	LEM	1	PASI-K
		EPA 300.0	OL	1	PASI-K
60151522003	**LEADWOOD UPSTREAM**	EPA 200.7	JGP	6	PASI-K
		EPA 200.7	JGP	3	PASI-K
		SM 2540D	JML	1	PASI-K
		EPA 300.0	OL	1	PASI-K
60151522004	**LEADWOOD DOWNSTREAM**	EPA 200.7	JGP	6	PASI-K
		EPA 200.7	JGP	3	PASI-K
		SM 2540D	JML	1	PASI-K
		EPA 300.0	OL	1	PASI-K

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ANALYTICAL RESULTS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Sample: LEADWOOD 001 **Lab ID: 60151522001** Collected: 08/21/13 09:53 Received: 08/22/13 08:30 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium	**2.6J**	ug/L	5.0	2.5	1	08/26/13 10:15	08/28/13 11:31	7440-43-9	
Lead	**4.6J**	ug/L	5.0	2.4	1	08/26/13 10:15	08/28/13 11:31	7439-92-1	
Zinc	**1710**	ug/L	50.0	3.3	1	08/26/13 10:15	08/28/13 11:31	7440-66-6	
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	ND	mg/L	5.0	5.0	1		08/23/13 14:59		
2540F Total Settleable Solids	Analytical Method: SM 2540F								
Total Settleable Solids	ND	mL/L/hr	0.20	0.20	1		08/22/20 13:00		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**233**	mg/L	50.0	8.0	50		08/26/13 16:21	14808-79-8	

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ANALYTICAL RESULTS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Sample: LEADWOOD 002 **Lab ID: 60151522002** Collected: 08/21/13 10:04 Received: 08/22/13 08:30 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium	**3.5J**	ug/L	5.0	2.5	1	08/26/13 10:15	08/28/13 11:37	7440-43-9	
Lead	**6.0**	ug/L	5.0	2.4	1	08/26/13 10:15	08/28/13 11:37	7439-92-1	
Zinc	**5310**	ug/L	50.0	3.3	1	08/26/13 10:15	08/28/13 11:37	7440-66-6	
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	ND	mg/L	5.0	5.0	1		08/23/13 15:00		
2540F Total Settleable Solids	Analytical Method: SM 2540F								
Total Settleable Solids	ND	mL/L/hr	0.20	0.20	1		08/22/20 13:00		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**420**	mg/L	50.0	8.0	50		08/26/13 16:37	14808-79-8	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Sample: LEADWOOD UPSTREAM **Lab ID: 60151522003** Collected: 08/21/13 09:40 Received: 08/22/13 08:30 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium	ND	ug/L	5.0	2.5	1	08/26/13 10:15	08/28/13 11:40	7440-43-9	
Calcium	**37300**	ug/L	100	10.4	1	08/26/13 10:15	08/28/13 11:40	7440-70-2	
Lead	ND	ug/L	5.0	2.4	1	08/26/13 10:15	08/28/13 11:40	7439-92-1	
Magnesium	**22100**	ug/L	50.0	6.5	1	08/26/13 10:15	08/28/13 11:40	7439-95-4	
Total Hardness by 2340B	**184000**	ug/L	500		1	08/26/13 10:15	08/28/13 11:40		
Zinc	ND	ug/L	50.0	3.3	1	08/26/13 10:15	08/28/13 11:40	7440-66-6	
200.7 Metals, Dissolved (LF)	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium, Dissolved	ND	ug/L	5.0	2.5	1	08/24/13 10:25	08/26/13 18:02	7440-43-9	
Lead, Dissolved	ND	ug/L	5.0	2.4	1	08/24/13 10:25	08/26/13 18:02	7439-92-1	
Zinc, Dissolved	ND	ug/L	50.0	3.3	1	08/24/13 10:25	08/26/13 18:02	7440-66-6	
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**5.0**	mg/L	5.0	5.0	1		08/27/13 13:32		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**15.1**	mg/L	2.0	0.32	2		08/26/13 17:24	14808-79-8	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Sample: LEADWOOD DOWNSTREAM **Lab ID: 60151522004** Collected: 08/21/13 09:24 Received: 08/22/13 08:30 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium	ND	ug/L	5.0	2.5	1	08/26/13 10:15	08/28/13 11:43	7440-43-9	
Calcium	**43900**	ug/L	100	10.4	1	08/26/13 10:15	08/28/13 11:43	7440-70-2	
Lead	**3.4J**	ug/L	5.0	2.4	1	08/26/13 10:15	08/28/13 11:43	7439-92-1	
Magnesium	**24800**	ug/L	50.0	6.5	1	08/26/13 10:15	08/28/13 11:43	7439-95-4	
Total Hardness by 2340B	**212000**	ug/L	500		1	08/26/13 10:15	08/28/13 11:43		
Zinc	**55.1**	ug/L	50.0	3.3	1	08/26/13 10:15	08/28/13 11:43	7440-66-6	
200.7 Metals, Dissolved (LF)	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Cadmium, Dissolved	ND	ug/L	5.0	2.5	1	08/24/13 10:25	08/26/13 18:05	7440-43-9	
Lead, Dissolved	ND	ug/L	5.0	2.4	1	08/24/13 10:25	08/26/13 18:05	7439-92-1	
Zinc, Dissolved	**36.9J**	ug/L	50.0	3.3	1	08/24/13 10:25	08/26/13 18:05	7440-66-6	
2540D Total Suspended Solids	Analytical Method: SM 2540D								
Total Suspended Solids	**12.0**	mg/L	5.0	5.0	1		08/27/13 13:32		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**27.2**	mg/L	5.0	0.80	5		08/26/13 17:39	14808-79-8	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

QC Batch: MPRP/23970 Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7 Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60151522001, 60151522002, 60151522003, 60151522004

METHOD BLANK: 1242325 Matrix: Water
Associated Lab Samples: 60151522001, 60151522002, 60151522003, 60151522004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Cadmium	ug/L	ND	5.0	08/28/13 10:53	
Calcium	ug/L	ND	100	08/28/13 10:53	
Lead	ug/L	ND	5.0	08/28/13 10:53	
Magnesium	ug/L	ND	50.0	08/28/13 10:53	
Total Hardness by 2340B	ug/L	ND	500	08/28/13 10:53	
Zinc	ug/L	ND	50.0	08/28/13 10:53	

LABORATORY CONTROL SAMPLE: 1242326

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Cadmium	ug/L	1000	981	98	85-115	
Calcium	ug/L	10000	9980	100	85-115	
Lead	ug/L	1000	1010	101	85-115	
Magnesium	ug/L	10000	9960	100	85-115	
Total Hardness by 2340B	ug/L		65900			
Zinc	ug/L	1000	1020	102	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1242327 1242328

Parameter	Units	60151385001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Cadmium	ug/L	ND	1000	1000	992	991	99	99	70-130	0	10	
Calcium	ug/L	45600	10000	10000	55100	55400	95	98	70-130	1	9	
Lead	ug/L	ND	1000	1000	994	991	99	99	70-130	0	10	
Magnesium	ug/L	5330	10000	10000	15200	15200	99	99	70-130	0	9	
Total Hardness by 2340B	ug/L	136000			200000	201000				0		
Zinc	ug/L	53.8	1000	1000	1070	1070	102	101	70-130	0	11	

MATRIX SPIKE SAMPLE: 1242329

Parameter	Units	60151522001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Cadmium	ug/L	2.6J	1000	1020	102	70-130	
Calcium	ug/L	127000	10000	132000	48	70-130	M1
Lead	ug/L	4.6J	1000	989	98	70-130	
Magnesium	ug/L	43100	10000	51100	80	70-130	
Total Hardness by 2340B	ug/L	496000		540000			
Zinc	ug/L	1710	1000	2600	89	70-130	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

QC Batch: MPRP/23964 Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7 Analysis Description: 200.7 Metals, Dissolved
Associated Lab Samples: 60151522003, 60151522004

METHOD BLANK: 1241871 Matrix: Water
Associated Lab Samples: 60151522003, 60151522004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Cadmium, Dissolved	ug/L	ND	5.0	08/26/13 15:47	
Lead, Dissolved	ug/L	ND	5.0	08/26/13 15:47	
Zinc, Dissolved	ug/L	ND	50.0	08/26/13 15:47	

LABORATORY CONTROL SAMPLE: 1241872

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Cadmium, Dissolved	ug/L	1000	979	98	85-115	
Lead, Dissolved	ug/L	1000	998	100	85-115	
Zinc, Dissolved	ug/L	1000	994	99	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1241873 1241874

Parameter	Units	60151516002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Cadmium, Dissolved	ug/L	ND	1000	1000	982	974	98	97	70-130	1	10	
Lead, Dissolved	ug/L	ND	1000	1000	987	980	99	98	70-130	1	10	
Zinc, Dissolved	ug/L	9.8J	1000	1000	991	976	98	97	70-130	2	11	

MATRIX SPIKE SAMPLE: 1241875

Parameter	Units	60151591001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Cadmium, Dissolved	ug/L	ND	1000	1000	100	70-130	
Lead, Dissolved	ug/L	ND	1000	954	95	70-130	
Zinc, Dissolved	ug/L	ND	1000	1000	99	70-130	

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QUALITY CONTROL DATA

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

QC Batch: WET/43037 Analysis Method: SM 2540D
QC Batch Method: SM 2540D Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 60151522001, 60151522002

METHOD BLANK: 1241325 Matrix: Water
Associated Lab Samples: 60151522001, 60151522002

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	ND	5.0	08/23/13 14:56	

SAMPLE DUPLICATE: 1241326

Parameter	Units	60151613001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	7.0	9.0	25	25	

SAMPLE DUPLICATE: 1241327

Parameter	Units	60151533008 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	18.0	17.0	6	25	

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QUALITY CONTROL DATA

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

QC Batch: WET/43075 Analysis Method: SM 2540D
QC Batch Method: SM 2540D Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 60151522003, 60151522004

METHOD BLANK: 1243041 Matrix: Water
Associated Lab Samples: 60151522003, 60151522004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	ND	5.0	08/27/13 13:30	

SAMPLE DUPLICATE: 1243042

Parameter	Units	60151648001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	12.0	10	18	25	

SAMPLE DUPLICATE: 1243043

Parameter	Units	60151528001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	131	131	0	25	

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

QC Batch: WETA/25939 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60151522001, 60151522002, 60151522003, 60151522004

METHOD BLANK: 1242295 Matrix: Water
Associated Lab Samples: 60151522001, 60151522002, 60151522003, 60151522004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfate	mg/L	ND	1.0	08/26/13 11:38	

LABORATORY CONTROL SAMPLE: 1242296

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	5	4.8	97	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1242297 1242298

Parameter	Units	60151085001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	ND	250	250	287	289	100	101	61-119	1	10	

MATRIX SPIKE SAMPLE: 1242299

Parameter	Units	60151516002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	28.3	25	56.8	114	61-119	

REPORT OF LABORATORY ANALYSIS

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QUALIFIERS

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-K Pace Analytical Services - Kansas City

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

Pace Analytical Services, Inc.
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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: NPDES MONTHLY (LEADWOOD)
Pace Project No.: 60151522

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60151522001	**LEADWOOD 001**	EPA 200.7	MPRP/23970	EPA 200.7	ICP/18752
60151522002	**LEADWOOD 002**	EPA 200.7	MPRP/23970	EPA 200.7	ICP/18752
60151522003	**LEADWOOD UPSTREAM**	EPA 200.7	MPRP/23970	EPA 200.7	ICP/18752
60151522004	**LEADWOOD DOWNSTREAM**	EPA 200.7	MPRP/23970	EPA 200.7	ICP/18752
60151522003	**LEADWOOD UPSTREAM**	EPA 200.7	MPRP/23964	EPA 200.7	ICP/18749
60151522004	**LEADWOOD DOWNSTREAM**	EPA 200.7	MPRP/23964	EPA 200.7	ICP/18749
60151522001	**LEADWOOD 001**	SM 2540D	WET/43037		
60151522002	**LEADWOOD 002**	SM 2540D	WET/43037		
60151522003	**LEADWOOD UPSTREAM**	SM 2540D	WET/43075		
60151522004	**LEADWOOD DOWNSTREAM**	SM 2540D	WET/43075		
60151522001	**LEADWOOD 001**	SM 2540F	WET/43016		
60151522002	**LEADWOOD 002**	SM 2540F	WET/43016		
60151522001	**LEADWOOD 001**	EPA 300.0	WETA/25939		
60151522002	**LEADWOOD 002**	EPA 300.0	WETA/25939		
60151522003	**LEADWOOD UPSTREAM**	EPA 300.0	WETA/25939		
60151522004	**LEADWOOD DOWNSTREAM**	EPA 300.0	WETA/25939		

Pace Analytical www.pacelabs.com

Sample Condition Upon Receipt

WO#: 60151522

60151522

Client Name: Doe Run

Optional
Proj Due Date:
Proj Name:

Courier: Fed Ex ☑ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ Other ☐

Tracking #: 7965 1143 5594 Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☐ Other ☑ Zplc

Thermometer Used: T-112 / T-194 Type of Ice: (Wet) Blue None ☐ Samples received on ice, cooling process has begun.
(circle one)

Cooler Temperature: 2.1

Temperature should be above freezing to 6°C

Date and initials of person examining contents: 8-22-13 BA

Chain of Custody present:	☑Yes ☐No ☐N/A	1.
Chain of Custody filled out:	☑Yes ☐No ☐N/A	2.
Chain of Custody relinquished:	☑Yes ☐No ☐N/A	3.
Sampler name & signature on COC:	☑Yes ☐No ☐N/A	4.
Samples arrived within holding time:	☑Yes ☐No ☐N/A	5.
Short Hold Time analyses (<72hr):	☑Yes ☐No ☐N/A	6. Self Sol
Rush Turn Around Time requested:	☐Yes ☑No ☐N/A	7.
Sufficient volume:	☑Yes ☐No ☐N/A	8.
Correct containers used:	☑Yes ☐No ☐N/A	
Pace containers used:	☑Yes ☐No ☐N/A	9.
Containers intact:	☑Yes ☐No ☐N/A	10.
Unpreserved 5035A soils frozen w/in 48hrs?	☐Yes ☐No ☑N/A	11.
Filtered volume received for dissolved tests?	☐Yes ☑No ☐N/A	12.
Sample labels match COC:	☑Yes ☐No ☐N/A	
Includes date/time/ID/analyses Matrix: WT		13.
All containers needing preservation have been checked.	☑Yes ☐No ☐N/A	
All containers needing preservation are found to be in compliance with EPA recommendation.	☑Yes ☐No ☐N/A	14.
Exceptions: VOA, coliform, TOC, O&G, WI-DRO (water), Phenolics	☐Yes ☑No	Initial when completed / Lot # of added preservative
Trip Blank present:	☐Yes ☐No ☑N/A	
Pace Trip Blank lot # (if purchased):		15.
Headspace in VOA vials (>6mm):	☐Yes ☐No ☑N/A	16.
Project sampled in USDA Regulated Area:	☐Yes ☐No ☑N/A	17. List State:

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

_____ _____ _____

_____ 8/22/13 _____

Project Manager Review: _____ Date: _____

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Pace Analytical
www.pacelabs.com

Section A — Required Client Information:

Company:	The Doe Run Company
Address:	PO Box 500
	Viburnum, MO 65566
Email To:	asanders@doerun.com
Phone: 573-689-4535	Fax: 573-244-8179
Requested Due Date/TAT:	5 - 7 Days

Section B — Required Project Information:

Report To:	Amy Sanders
Copy To:	
Purchase Order No.:	
Project Name:	NPDES Monthly (Leadwood)
Project Number:	

Section C — Invoice Information:

Attention:	Amy Sanders
Company Name:	The Doe Run Company
Address:	PO Box 500, Viburnum, MO 65566
Pace Quote Reference:	
Pace Project Manager:	Jamie Church
Pace Profile #:	

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☑ OTHER _____

Site Location STATE: MO

Section D — Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

Requested Analysis Filtered (Y/N)

ITEM #	Section D: SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	TSS	Settleable Solids	Sulfate	Cd, Pb, Zn - Total	Hardness	Cd, Pb, Zn - Dissolved							Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
																			N	N	N	N	N	N							
1	Leadwood 001	WW	G			8/21/13	0953	19	3	2		1							X	X	X	X								N	10915522
2	Leadwood 002	WW	G			8/21/13	1004	13	3	1		1							X	X	X	X								N	
3	Leadwood Upstream	W	G			8/21/13	0940	14	2	1		1							X		X	X	X	X						N	
4	Leadwood Downstream	W	G			8/21/13	0924	13	2	1		1							X		X	X	X	X						N	
5																															
6																															
7																															
8																															
9																															
10																															
11																															
12																															

Pace Project No./ Lab I.D.: 10915522

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
* 200.8 Total Recoeverable Metals	Larry Hopkins	8/21/13	1206	Kenneth Cox / PACE	8-22-13	0830	2.1	Y	Y	Y
**analyzed within 24 hours with flagged data										

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Larry Hopkins

SIGNATURE of SAMPLER: Larry Hopkins

DATE Signed (MM/DD/YY): 8/21/13

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Gunter, Jason

From: Nations, Mark [mnations@doerun.com]
Sent: Tuesday, January 14, 2014 8:35 AM
To: Gunter, Jason
Subject: RE: Leadwood Progress Report
Attachments: Inspection Report 10.16.2013.docx; DrawingsC-01-C-05.pdf

Categories: Red Category

Jason, attached is the inspection with drawings. As for LW and RM, I was wondering when you planned on being on site.

From: Gunter, Jason [mailto:gunter.jason@epa.gov]
Sent: Monday, January 13, 2014 11:25 AM
To: Nations, Mark
Cc: Yingling, Mark; Wohl, Matthew; robert.hinkson@dnr.mo.gov; brandon.wiles@dnr.mo.gov; Sanders, Amy B.; Cummings, Mark; Ty Morris (TMorris@barr.com)
Subject: RE: Leadwood Progress Report

Hi Mark,

Was wondering when we will receive the information on the inspection of the Leadwood Decant Tower. Also, are there any developments on the treatment cells for Leadwood?

Thanks,

Jason Gunter
Remedial Project Manager
US EPA Region 7
11201 Renner Blvd.
Lenexa, KS. 66219
Office: 913-551-7358
Cell: 913-302-9144

From: Nations, Mark [mailto:mnations@doerun.com]
Sent: Monday, January 13, 2014 10:34 AM
To: Gunter, Jason
Cc: Yingling, Mark; Wohl, Matthew; robert.hinkson@dnr.mo.gov; brandon.wiles@dnr.mo.gov; Sanders, Amy B.; Cummings, Mark; Ty Morris (TMorris@barr.com)
Subject: Leadwood Progress Report

Jason,
Attached is the December report.
Let me know if you have questions.
Mark

07CR 30290259 4.2
Superfund
0402

Leadwood Mine Tailings Impoundment

Inspection of Leadwood Dam Decant Structure

Prepared for
The Doe Run Company

October 2013

Leadwood Mine Tailings Impoundment

Inspection of Leadwood Dam Decant Structure

Prepared for
The Doe Run Company

October 2013

BARR

1001 Diamond Ridge, Suite 1100
Jefferson City, MO 65109
Phone: (573) 638-5000
Fax: (573) 638-5001

Inspection of Leadwood Dam Decant Structure

October 2013

Table of Contents

List of Appendices

1.0 Background

1.1 Structure Overview

The Leadwood Tailings basin near Leadwood, MO drains approximately 3.5 square miles of land owned by The Doe Run Company (Doe Run) and private entities. The majority of the runoff from the site is conveyed through a decant tower structure and culvert at the north end of the site near Outfall 001. The decant tower is approximately 42 feet in depth. The tower is divided by a central wall into two separate shafts each 5 feet wide by 5.5 feet long. The dividing wall ends at a chamber in the bottom of the tower. There, flow is directed into a 5 feet wide by six feet high concrete box culvert that is approximately 550 feet long.

The inlet to the decant structure is situated at the surface of the elevated tailings impoundment stabilized by an earthen embankment. Fine sediment known as "slimes" has historically collected in a large volume around the decant structure inlet and around the tower walls. Medium grained sediment (tailings) is also present around the tower inlet and walls.

The culvert runs through the base of the Leadwood dam (permit number MO30274) and discharges at the toe , from where stormwater runoff flows a short distance to Outfall 001.

1.2 Purpose of Inspection

Field personnel from Doe Run and Barr Engineering Company (Barr) have previously observed seepage through cracks in the decant tower walls, as well as infiltration of sediment through some of the cracks. The volumetric flow rate of this seepage varies from no flow to approximately 1,000 gallons per minute, depending on site conditions. Ongoing concrete deterioration of the tower has been observed.

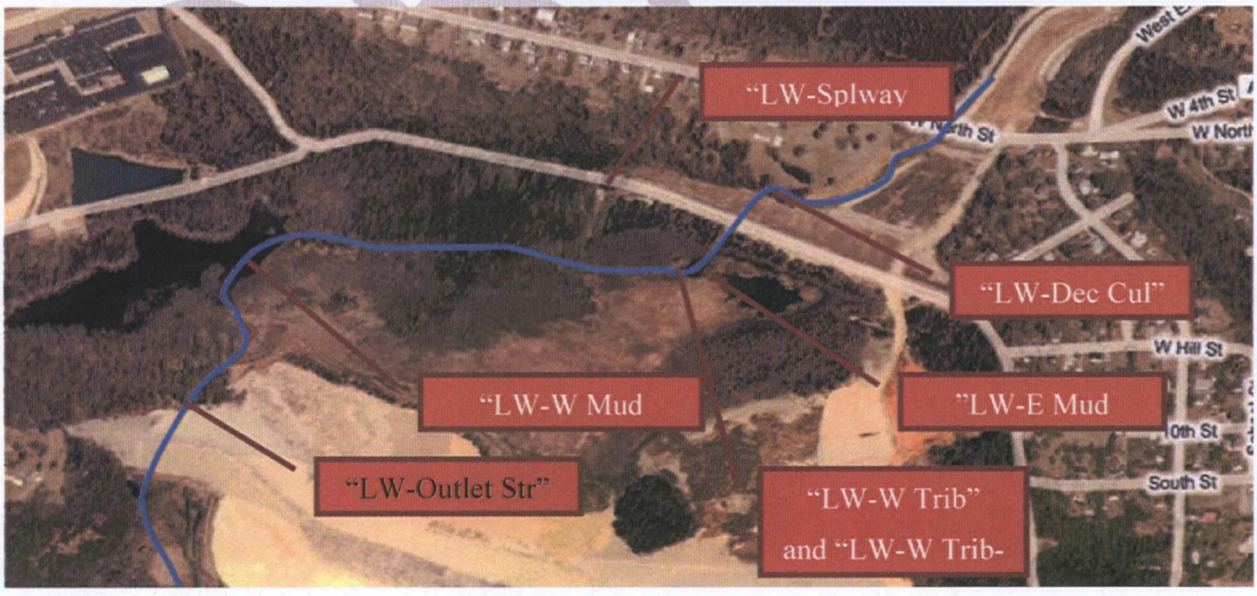
In addition to the aforementioned field observations, grab samples of water were acquired from the flows leading to the decant structure, the pools of water near the decant tower inlet, and the discharge from the decant tower culvert. These samples showed increased concentrations of metals following the conveyance of water through the decant structure, particularly with regards to lead and zinc. The results are displayed in Table 1 and the sampling locations are depicted in Figure 1. Because

elevated lead and zinc concentrations are found in the tailings, this suggests that seepage from the surrounding tailings is contributing to elevated levels of these pollutants.

Table 1 – Concentrations of Zinc and Lead (Total and Dissolved)

Date	General Site Condition	Location	Parameter (mg/L unless otherwise specified)				
			Flowrate (gpm)	Zinc-Dissolved	Zinc-Total	Lead-Dissolved	Lead-Total
4/10/2012	Normal	LW-Outlet Str	250	0.153	0.166	0	0
		LW-W Mud Pond	Stagnant	0.0384	0.0688	0	0
		LW-Splway Cul	340	0.113	0.123	0	0
		LW-Dec Cul	450	0.156	0.198	<.04	0.07
		LW-E Mud Pond	8 (Pond Eff.)	0.0197	0.0228	0	0
5/3/2012	Dry	LW-Outlet Str	25 (est.)	0.192	0.23	0.0064	<.04
		LW-W Mud Pond	Stagnant	0.0588	0.0722	0.016	0.028
		LW-Splway Cul	9	0.147	0.184	<.04	0.019
		LW-Dec Cul	140	0.184	0.29	0.012	0.146
		LW-E Mud Pond	8 (Pond Eff.)	0.0611	0.0778	0.01	0.025
5/30/2012	Very Dry	LW-W Mud Pond	Stagnant	0	0.026	0.0041	0.0432
		LW-W Trib	Low	0.0712	0.202	0.0127	0.322
		LW-Dec Cul	140 (est.)	0.245	0.426	0.014	0.378
9/28/2012	Very Dry	LW-W Trib	2 (est.)	1.27	1.4	<.04	0.086
		LW-W Trib-b	8 (est.)	1.41	1.66	<.04	0.501
		LW-Dec Cul	12 (est.)	2.14	2.34	0.041	0.098

Figure 1 – Sampling locations; "LW-Outlet Str" is upstream of all other sampling locations, while "LW-Dec Cul" is downstream of all other sampling locations



For this reason, Barr is evaluating options to remediate the decant structure to reduce the infiltration of seepage from the surrounding tailings and minimize metals contamination in the discharge from the decant tower. As part of this effort, Barr completed a detailed structural inspection of the inside of the tower and culvert, to determine the overall condition of the concrete, identify any specific problem areas, and to obtain a better understanding of the potential sediment and groundwater transport that may be occurring so that renovation plans could be reliably developed. This inspection occurred on August 29, 2013.

This report details the findings of the inspection, and gives preliminary overviews of potential design options for the decant tower structure, as well as potential future investigative measures.

1.3 Inspection Description and Site Preparation

The inspection occurred in two phases. In the first phase, the decant tower occurred using a boom truck equipped with a man basket, that lowered two Barr personnel down each shaft to take measurements and make observations. In the second phase, the decant culvert was inspected by two Barr personnel who walked the length of the decant tower culvert to take measurements and make observations.

Preparation for the inspection included blocking surface flow to the decant tower using a clay berm, developing fall protection measures, and laying stone surfaces nearby for equipment use.

2.0 Inspection Findings

2.1 Tower Shafts

2.1.1 General Observations

Deterioration of the concrete was present in both towers. This included surface spalling, deeper pockets that have formed in certain areas of the walls, exposure of rebar, cracking, and gaps at seams. Where spalling and other damage have not occurred, the concrete was determined to be sound.

Some areas of the tower wall were dry, while others were wet or had visible flow down the sides of them. Areas with visible flow down the sides were observed to be from infiltration of water through the tower walls. It is unknown whether wet areas with no visible flow were moist due to infiltration of water or due to condensation.

Staining was present on the walls of the tower, and included green algal growth, black residual discoloration, orange residual discoloration, white residual discoloration, and grey residual coloration. Soil/Sediment deposits were present on some walls in layers up to ½ inch thick in some locations. The assumed (not definitive) causes of the sediment and discoloration are as follows:

- The thicker sediment on the west walls appears to be the result of ongoing and continuous water flow through large gaps between the upper concrete bulkhead and the older portions of the tower structure.

- The source of the black discoloration is not exactly known. However, manganese precipitation is known to cause black precipitants and is also commonly associated with dissolved iron in groundwater. In this case, it is reasonable to infer that since significant levels of dissolved iron are known to exist in the seepage, the black precipitants could be the results of manganese oxidation. This would further substantiate that seepage from the tailings is infiltrating the decant tower. This discoloration was present mainly on the middle dividing wall and towards the bottom of the shaft.

- The orange residual discoloration is thought to be caused from the presence of iron reducing bacteria that thrive off the oxygen from the iron oxidation process. This discoloration is known to occur when water with a high dissolved iron concentration from an anaerobic environment surfaces into an aerobic environment creating iron oxide (Fe_2O_3). This phenomenon has been observed in other locations on the Leadwood site, particularly at the toes of earthen embankments where groundwater is known to surface. The presence of this discoloration suggests the presence of the infiltration of seepage from the surrounding tailings.

- The white and grey residual discoloration is anticipated to be sediment from the impoundment that has infiltrated through cracks in the tower walls.

Figures C-02 and C-03 show specific locations where seepage was occurring and gives an overview of the more relevant areas of tower damage. Sections 2.1.2 and 2.1.3 below give overviews of specific observations in the tower shafts.

2.1.2 South Shaft

Specific observations in the south shaft are as follows:

- Approximately 10 feet below the top of concrete on the west wall, there is a concrete bulkhead blocking a 5.5 feet by 7 feet opening in the main shaft wall. A large volume of water has continuously been observed flowing through the bottom seam between the bulkhead and wall opening. The flow rate out of the seam varies based on surface conditions but is estimated to have be as high as 1,000 gallons a minute. During low flow conditions, grey sediment has been observed on the bottom ledge of the opening (See Photographs 1 and 2 in Appendix B).

- Approximately 28 feet below the top of the concrete, a form board is present at a seam on the east wall. Beneath the form board in the south-east corner of the shaft, water infiltration was occurring at an estimated rate of 2 gallons per minute. A fine, light grey sediment was suspended in the water, and had created a light gray trail of residue down the side of the tower shaft (See Photograph 3 in Appendix B).

- Approximately 33 feet below the top of the concrete, in the south-west corner of the shaft, a large gap was present. The gap was tapered with a maximum width of 5 inches, and extended about 20 inches into the wall. A flat solid surface was encountered at the back of this cavity, and is assumed to be a concrete bulkhead. The gap was very wet, however it is unclear whether seepage from the surrounding tailings was infiltrating at this location or if the water was a result of condensation or water flowing from cracks higher in the wall (See Photograph 4 in Appendix B).

2.1.3 North Shaft

Specific observations in the north shaft are as follows:

- Approximately 9 feet below the top of the concrete in the north-east corner of the shaft, several small cracks were releasing orange colored sediment. The sediment had accumulated in a trail down the side of the shaft wall and was fine to medium grained. The cracks were wet (See Photograph 5 in Appendix B).

- Approximately 10 feet below the top of the concrete on the west wall, there is a concrete bulkhead blocking a 5.5 feet by 7 feet opening in the main shaft wall. Unlike the south shaft observations at this elevation, no visible flow from the seams between the opening and the bulkhead were observed, however the area was wet, and layers of sediment up to a ½" thick were present below the lower seam, suggesting flow from the seam in the past. There is also a hole in the divider wall between the north and south shafts present near this elevation and it is possible that water from the south shaft passed through this opening into the north shaft in some higher flow conditions (See Photograph 6 in Appendix B).

- Approximately 17 feet below the top of the concrete a crack in the north-west corner of the shaft showed signs of the same white residue noted in the south shaft. No visible discharge appeared to be coming from the opening during the inspection (See Photograph 7 in Appendix B).

- Approximately 35 feet below the top of the concrete in the south-west corner of the shaft two separate locations had collected a white residue. The pattern observed indicates the residue

was suspended in flowing water when it was deposited. These locations were not observed to be flowing during the inspection (See Photograph 8 in Appendix B).

2.2 Culvert

2.2.1 Culvert Condition

The culvert was in good condition. The concrete was found to be hard when hit with a hammer, indicating overall strength of the concrete was still very high. There were only limited amounts of spalling and general deterioration. The primary observation within the culvert was the presence of efflorescence and hard mineral deposit at culvert seams and some vertical cracks. This observation was made all along the length of the culvert, but generally does not affect the overall strength of the culvert or its functionality. This is described further in Section 2.2.2.

There were several minor cracks along the length of the culvert. There were also two locations where the seams of two sections of the culvert were misaligned. These were at 192 feet in from the culvert discharge and 199 feet in from the culvert discharge.

2.2.2 Mineralization

Calcium efflorescence is caused when water passes through concrete and accumulates concentrations of calcium, which then mineralizes into a solid substance when reaching the surface of the concrete. It is identified by a white crystalized mineral. Efflorescence existed at most of the culvert seams and at some vertical cracks along the length of the culvert. The size of the calcium deposits generally increased and became darker in color as the inspection proceeded toward the tower. The largest deposits were in the south end near the tower chambers.

The presence of iron bacteria and darker discoloration was observed approximately 100 lineal feet from the culvert discharge. It continued to be present at seams and cracks through the rest of the length of the culvert leading to the decant tower. The mineralization varied from surface discoloration to formations that protruded as much as 6 inches from the concrete surface and formed stalactites from seams and fissures in the culvert ceiling (See Photograph 9 in Appendix B).

2.2.3 Seepage

Infiltration of water was first observed at a seam 112 lineal feet from the culvert discharge, and was observed at several other locations along the length of the culvert. Infiltration was only observed at seams and fissures. The highest spot sources of seepage (each approximately 2 gallons a minute) into the culvert were occurring at misaligned joints between 190 and 200 feet from the culvert discharge. A large amount of mineralization was present at most locations of seepage into the culvert.

Dripping from the ceiling was first observed 97 lineal feet from the culvert discharge, and continued through the rest of the length of the culvert. It is assumed that the dripping from the ceiling was the resultant of condensation, with the exception of more concentrated dripping at seams and cracks.

2.3 Conclusion

It is our opinion that the primary infiltration of sediment is occurring at the decant tower. Additional water infiltration is occurring at cracks and joints in the culvert, but the magnitude of this water infiltration appears to be small compared to the flow in the tower.

The elevated levels of metals is believed to be resultant of tailings sediment being washed into the decant tower and water seepage from the surrounding tailings infiltrating the tower and culvert. Strong evidence of sediment was observed in the tower during the inspection. It was difficult to tell if the sediment on the floor of the culvert was washing down the culvert from the tower, but there was not sediment observed at any of the cracks or joints in the culvert. The primary sources of infiltration of sediment are described in Sections 2.1.2 and 2.1.3.

The highest volume of seepage is coming from the seam in the south tower shaft, as described in Section 2.1.2. Point sources of the infiltration of seepage were observed in several other locations in the tower and the culvert, and were generally observed at flowrates of less than 2 gallons per minutes. The presence of mineralization and moisture in other areas suggest minute seepage in other locations, although in quantities too small to be accurately measured or observed. It is also assumed static hydraulic pressure will be greatest at the bottom of the tower shaft, and at the south end of the culvert, and will result in the largest likelihood of seepage infiltrating into the structure. This is

supported by the observation that mineralization within the culvert was greatest at seams and fissures in the south end of the culvert (the phreatic water surface is believed to decrease along with the centerline of the culvert, gradually reducing hydrostatic pressure to zero near the culvert discharge).

Potential mitigation of sediment infiltration should therefore focus on the decant tower. Potential mitigation of groundwater infiltration should focus on both the decant tower and the culvert cracks and joints.

3.0 Recommendations for Remediation and Further Actions

3.1 Primary Options for Tower and Culvert Remediation

The following primary options for remediation of the metals contamination believed to be caused by the condition of the decant structure and conduit are offered for consideration. Options include the following:

- **Rehab of Tower** –Plastic, metal, or concrete shafts could be inserted into the existing tower and grouted in place, to isolate surface water from groundwater and restrict seepage into the decant structure. This could be combined with other approaches to mitigate the issues in the towers and culvert.

- **Crack Injection** –Expanding sealant could be injected under high pressure to seal cracks where groundwater infiltrates. This could be used in both the tower and culvert. Larger cracks would have to be detailed separately, as injectable resins are generally limited to small cracks.

- **Incremental Approach** - An incremental approach could be taken, whereby tower remediation is implemented and sampling continues to determine if the tower remediation succeeded in reducing the metals contamination to acceptable levels.

3.2 Secondary Options for Tower and Culvert Remediation

Secondary options were also considered for the remediation of the decant structure. These were not included with the primary options discussed in Section 3.1 because they will either need further investigation to be conclusively deemed reliable, as they may not be cost effective or were shown through experience on similar applications to be challenging to implement. Although Barr recommends consideration of the primary rehabilitation options discussed in Section 3.1, the options below were included in this report as additional options for consideration:

- **Abandonment of Decant Tower as Primary Drainage Structure**-This option would entail directing surface flow down the spillway channel rather than through the decant tower. Remediation of the decant tower would be limited to the most problematic locations (such as the seam shown in Photograph 1 in Appendix B), and any remaining seepage into the structure would be collected at the culvert discharge and directed to coincide with seepage water surfacing at the toe of the earthen embankment, where a pump station is currently planned for water treatment/water management purposes. This option would require further analysis of surface hydrology/hydraulics, government regulations pertaining to dams, and evaluation of the spillway channel characteristics.

- **Coating of Tower and Culvert Interior**-Products are available which would be applied to the inside of the decant tower shaft and culvert to prevent leakage. This is likely to be a short-term solution and may not be viable due to the ongoing infiltration of water.

- **Coating of Tower Exterior**-The tower could be excavated, and a coating applied to the exterior to seal and protect the tower from infiltration. This could be combined with other approaches to mitigate the issues in the conduit. This is included as a secondary option due to water control and tailings management issues that would likely arise due to excavation.

3.3 Immediate and Future Actions

Barr recommends that DRC proceed to develop preliminary designs and costs for the implementation of the primary options presented in Section 3.1 of the report for the rehabilitation of the towers and culvert.

Appendix A

Figures

Appendix B

Photograph Log

Photograph 1-Seam at concrete bulkhead, south shaft, looking west; this location was observed to be the primary source of seepage into the decant structure

Photograph 2-Seam at concrete bulkhead, south shaft, looking southwest; red sediment is clay that was used for water control, and was deposited during inspection preparation; gray sediment is assumed to be scouring into the decant structure

Photograph 3-Fine white sediment infiltrating tower, south shaft, looking southeast

Photograph 4-Large gap at seam, south shaft, looking southwest

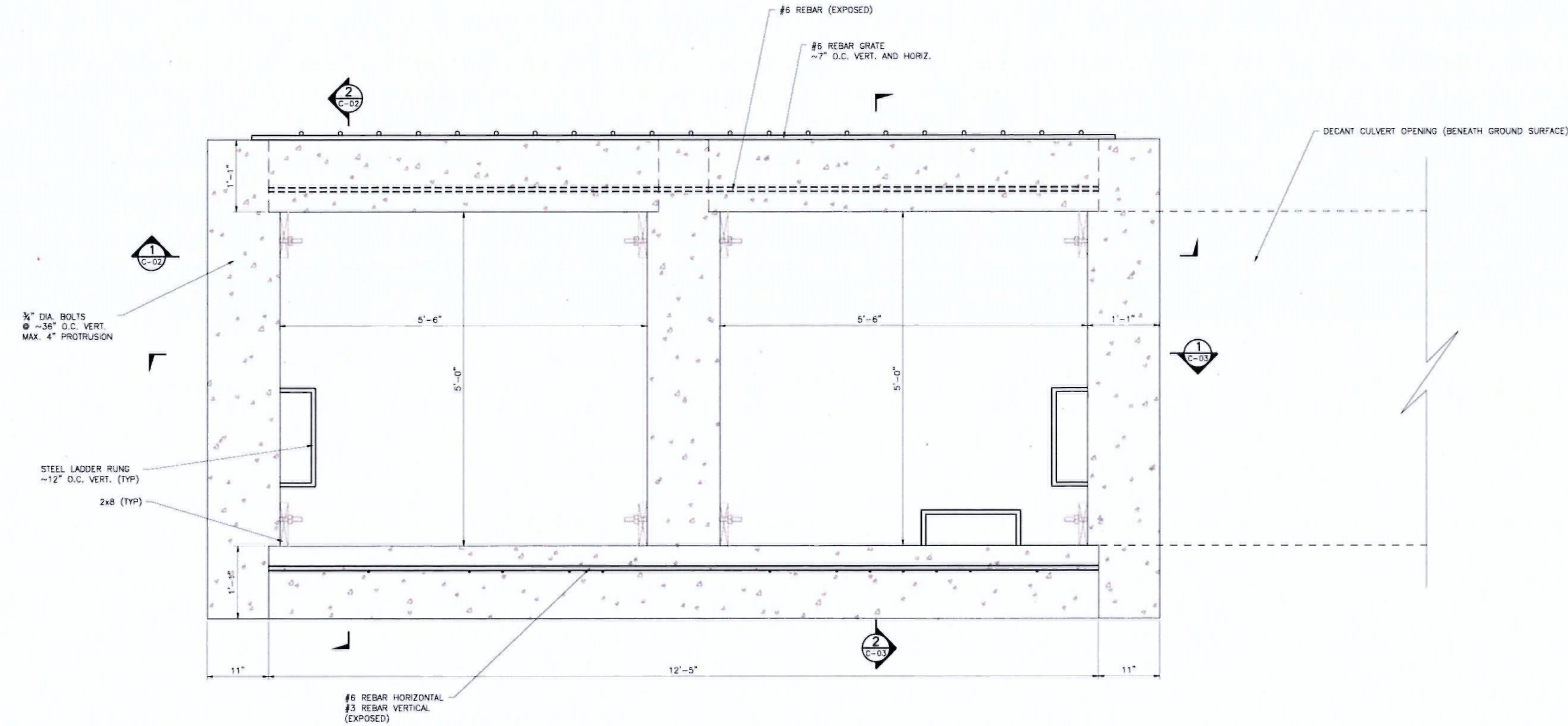
Photograph 5-Cracks with sediment infiltrating tower, north shaft, looking northeast

Photograph 6-Bulkhead interface, north shaft, looking northwest

Photograph 7-White sediment infiltrating tower, north shaft, looking northwest

Photograph 8-White residue deposited from two separate point sources, north shaft, looking southeast

Photograph 9-Mineralization (iron oxidation and efflorescence) in culvert, approximately 450 lineal feet from culvert discharge, looking southeast



1 C-01 PLAN: DECANT TOWER

0 10 20 SCALE IN FEET

PRELIMINARY DRAFT

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT / BID / CONSTRUCTION — RELEASED TO/FOR — A B C 0 1 2 3 — DATE RELEASED

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Date	09/30/13
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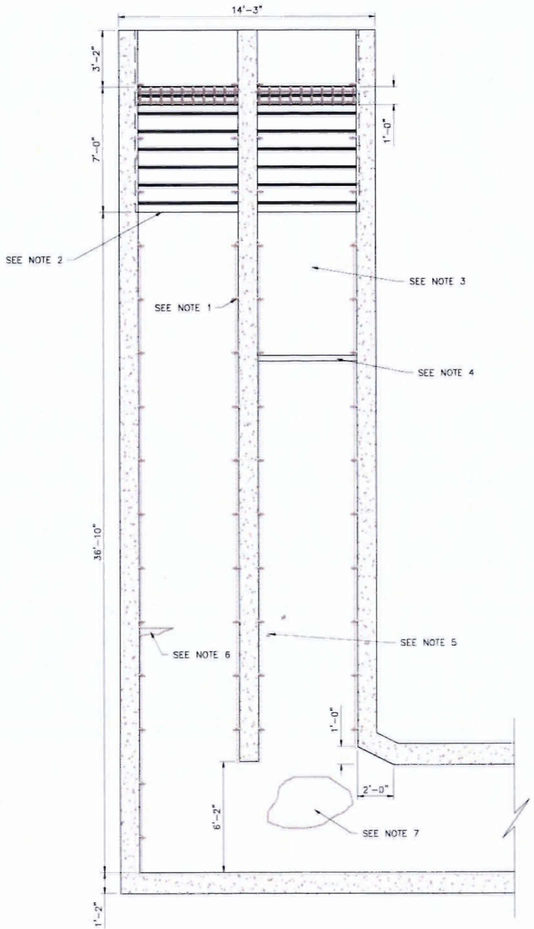
DOE RUN COMPANY
ST. LOUIS, MO

LEADWOOD DECANT TOWER INSPECTION
LEADWOOD, MO

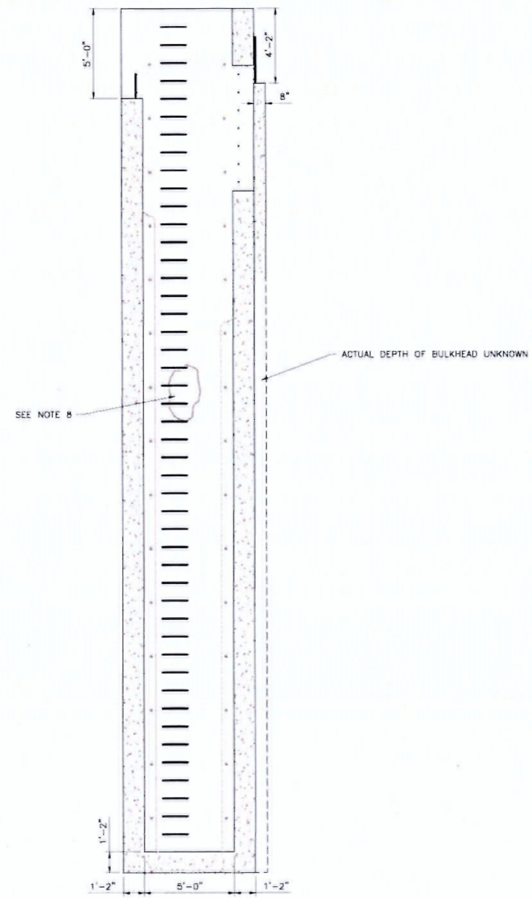
DECANT TOWER SHAFT
PLAN VIEW

BARR PROJECT No. 25861002.00
CLIENT PROJECT No.
DWG. No. C-01
REV. No. 0



(1/C-01) SECTION: DECANT TOWER WEST WALL

0 40 80
SCALE IN FEET



(2/C-01) SECTION: DECANT TOWER SOUTH WALL

0 40 80
SCALE IN FEET

NOTES

1. EACH CORNER WAS CONSTRUCTED WITH 2X8 RUNNER BOARDS HELD IN PLACE BY ¾" DIAMETER BOLTS. BOTH BOLTS AND BOARDS ARE HEAVILY DETERIORATED. DRAWING DOES NOT DEPICT DETAILS OF DETERIORATION.

2. SEAM IN SOUTH SHAFT IS LEAKING. FLOWRATE FROM SEAM IS BETWEEN 0 AND 1,000 GALLONS PER MINUTE, DEPENDING ON SURFACE CONDITIONS. GREY SEDIMENT (PRESUMED SLIMES AND TAILINGS) HAVE BEEN OBSERVED LEAVING THIS SEAM.

3. A TAPERED TRAIL OF RESIDUE WAS OBSERVED IN THIS LOCATION (EXTENDING DOWNWARD FROM SEAM), SUGGESTING GROUND WATER SEEPAGE. NO SEEPAGE WAS VIEWED DURING INSPECTION. AREA WAS MOIST DURING INSPECTION.

4. THIS JOINT HAS A LEDGE THAT STICKS OUT HORIZONTALLY A MAXIMUM OF 6 INCHES. THE LEDGE IS FLAT ON TOP AND IS FORMED SO ITS SURFACE RUNS DIAGONALLY DOWNWARD UNTIL IT BECOMES FLUSH WITH THE WALL.

5. WHITE RESIDUE WAS OBSERVED TO HAVE COLLECTED IN THIS LOCATION. THE RESIDUE APPEARED TO HAVE COME FROM TWO SEPARATE POINT SOURCES IN CLOSE PROXIMITY TO EACH OTHER. NO VISIBLE SEEPAGE WAS OBSERVED AT THESE SOURCES DURING INSPECTION.

6. A LARGE GAP WAS PRESENT AT THIS SEAM. GAP WAS APPROXIMATELY A MAXIMUM OF 4 INCHES IN HEIGHT, AND TAPERED IN THE NORTHWARD DIRECTION. GAP EXTENDED THROUGH WALL TO BULKHEAD. IT WAS UNDETERMINED WHETHER SEEPAGE WAS OCCURRING THROUGH THIS GAP.

7. THIS AREA HAS NUMEROUS POCKETS WITH AN APPROXIMATE MAXIMUM DEPTH OF 5". REBAR IS EXPOSED IN SOME OF THESE POCKETS.

8. POCKETS WERE OBSERVED IN THIS LOCATION.

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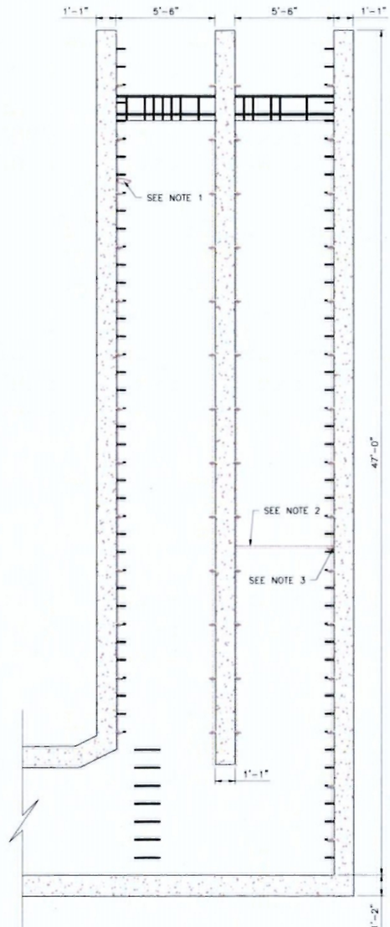
DOE RUN COMPANY
ST. LOUIS, MO

DECANT TOWER INSPECTION
LEADWOOD, MO

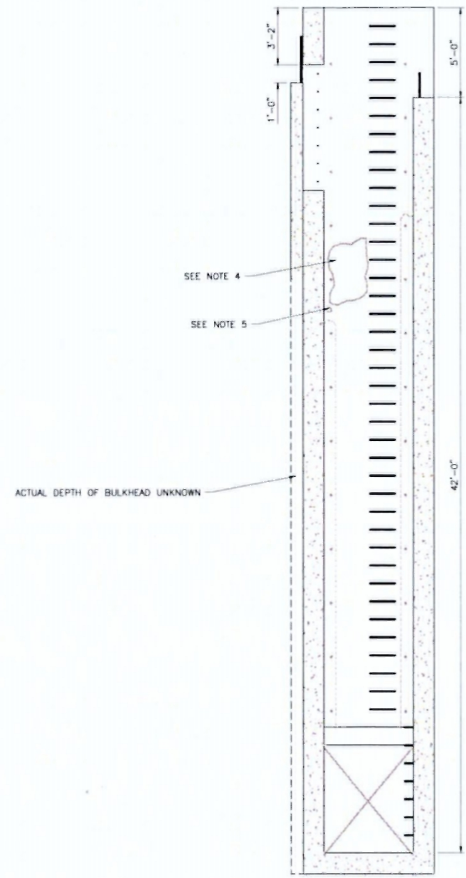
DECANT TOWER SHAFT
SECTION VIEWS

BARR PROJECT No. 25861002.00
CLIENT PROJECT No.
DWG. No. C-02
REV. No. 0



1 SECTION: DECANT TOWER EAST WALL

C-01 — 0 40 80 SCALE IN FEET



2 SECTION: DECANT TOWER EAST WALL

C-01 — 0 40 80 SCALE IN FEET

NOTES

1. INFILTRATION OF AN ORANGE SEDIMENT WAS OBSERVED HERE. SEDIMENT COLLECTION HAS OCCURRED DOWN THE WALL SEVERAL FEET, AND CONSISTED OF A FINE TO MEDIUM SAND.

2. A FORM BOARD WAS LEFT IN PLACE HERE. THE FORM BOARD IS SLOWLY DECOMPOSING, AND SHOWS DETERIORATION PARTICULARLY AT THE INTERFACE WITH THE CONCRETE AND AT THE ENDS. SEEPAGE WAS OBSERVED AND INCLUDED INFILTRATION OF SEDIMENT.

3. SEDIMENT INFILTRATION WAS HIGHEST AT THIS CORNER OF THE FORM BOARD DESCRIBED IN NOTE 2. SEDIMENT WAS WHITE TO LIGHT GRAY IN COLOR AND WAS VERY FINE (PRESUMED TO BE SLIMES). A RESIDUAL TRAIL OF THE SEDIMENT WAS PRESENT FOR SEVERAL FEET DOWN THE SIDE OF THE WALL.

4. THIS AREA CONTAINS SEVERAL POCKETS 4" TO 5" DEEP.

5. WHITE RESIDUE WAS OBSERVED LEAKING FROM THIS LOCATION.

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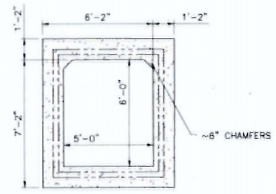
DOE RUN COMPANY
LEADWOOD, MO

LEADWOOD DECANT TOWER INSPECTION
LEADWOOD, MO

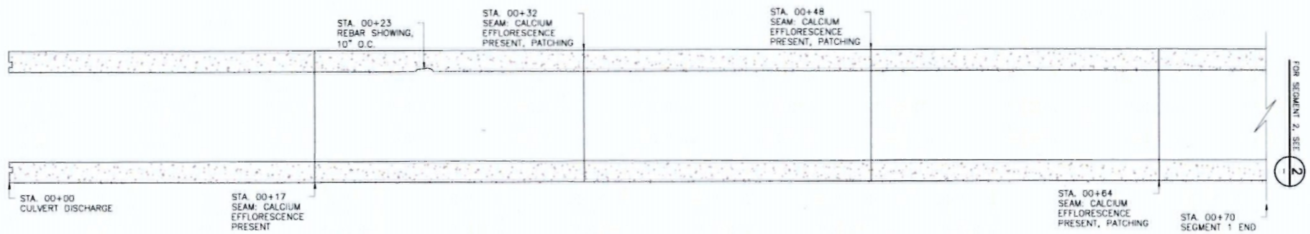
DECANT TOWER SHAFTS
SECTION VIEWS

BARR PROJECT No.	25861002.00
CLIENT PROJECT No.	
DWG. No.	C-03
REV. No.	0



1 ELEVATION: DECANT TOWER CULVERT

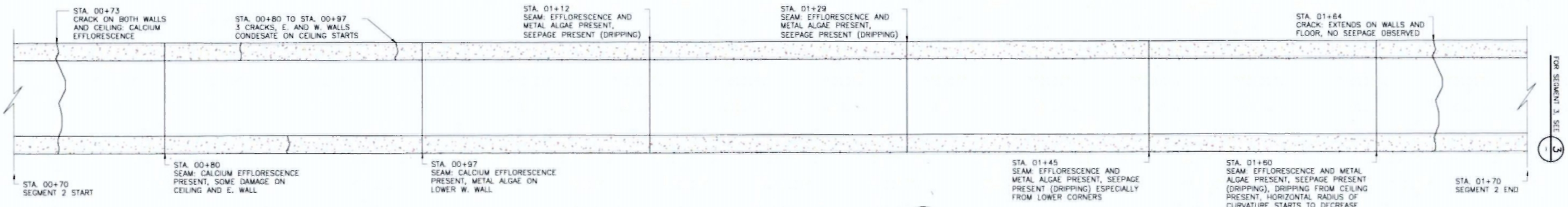
0 40 80 SCALE IN FEET



STA. 00+23 REBAR SHOWING; 10" O.C.
STA. 00+32 SEAM: CALCIUM EFFLORESCENCE PRESENT, PATCHING
STA. 00+48 SEAM: CALCIUM EFFLORESCENCE PRESENT, PATCHING
FOR SEGMENT 2, SEE 2
STA. 00+00 CULVERT DISCHARGE
STA. 00+17 SEAM: CALCIUM EFFLORESCENCE PRESENT
STA. 00+64 SEAM: CALCIUM EFFLORESCENCE PRESENT, PATCHING
STA. 00+70 SEGMENT 1 END

1 SECTION: DECANT CULVERT-SEGMENT 1

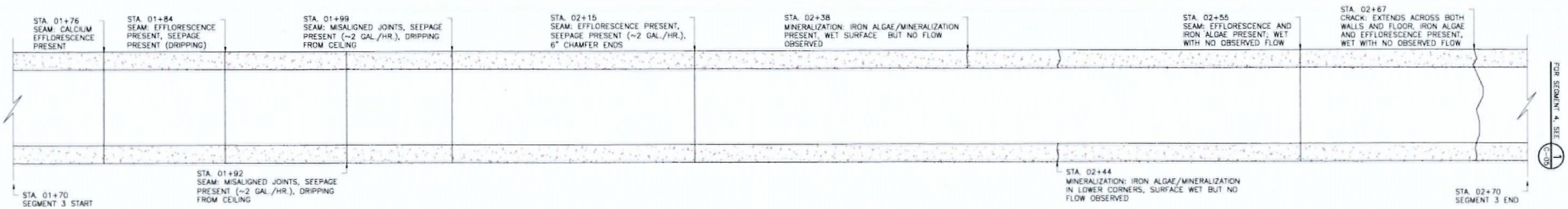
0 40 80 SCALE IN FEET



STA. 00+73 CRACK ON BOTH WALLS AND CEILING; CALCIUM EFFLORESCENCE
STA. 00+80 TO STA. 00+97 3 CRACKS, E. AND W. WALLS CONDESATE ON CEILING STARTS
STA. 01+12 SEAM: EFFLORESCENCE AND METAL ALGAE PRESENT, SEEPAGE PRESENT (DRIPPING)
STA. 01+29 SEAM: EFFLORESCENCE AND METAL ALGAE PRESENT, SEEPAGE PRESENT (DRIPPING)
STA. 01+64 CRACK: EXTENDS ON WALLS AND FLOOR, NO SEEPAGE OBSERVED
FOR SEGMENT 3, SEE 3
STA. 00+70 SEGMENT 2 START
STA. 00+80 SEAM: CALCIUM EFFLORESCENCE PRESENT, SOME DAMAGE ON CEILING AND E. WALL
STA. 00+97 SEAM: CALCIUM EFFLORESCENCE PRESENT, METAL ALGAE ON LOWER W. WALL
STA. 01+45 SEAM: EFFLORESCENCE AND METAL ALGAE PRESENT, SEEPAGE PRESENT (DRIPPING) ESPECIALLY FROM LOWER CORNERS
STA. 01+60 SEAM: EFFLORESCENCE AND METAL ALGAE PRESENT, SEEPAGE PRESENT (DRIPPING), DRIPPING FROM CEILING PRESENT, HORIZONTAL RADIUS OF CURVATURE STARTS TO DECREASE
STA. 01+70 SEGMENT 2 END

2 SECTION: DECANT CULVERT-SEGMENT 2

0 40 80 SCALE IN FEET



STA. 01+76 SEAM: CALCIUM EFFLORESCENCE PRESENT
STA. 01+84 SEAM: EFFLORESCENCE PRESENT, SEEPAGE PRESENT (DRIPPING)
STA. 01+99 SEAM: MISALIGNED JOINTS, SEEPAGE PRESENT (~2 GAL./HR.), DRIPPING FROM CEILING
STA. 02+15 SEAM: EFFLORESCENCE PRESENT, SEEPAGE PRESENT (~2 GAL./HR.), 6" CHAMFER ENDS
STA. 02+38 MINERALIZATION: IRON ALGAE/MINERALIZATION PRESENT, WET SURFACE BUT NO FLOW OBSERVED
STA. 02+55 SEAM: EFFLORESCENCE AND IRON ALGAE PRESENT, WET WITH NO OBSERVED FLOW
STA. 02+67 CRACK: EXTENDS ACROSS BOTH WALLS AND FLOOR, IRON ALGAE AND EFFLORESCENCE PRESENT, WET WITH NO OBSERVED FLOW
FOR SEGMENT 4, SEE 1 C-05
STA. 01+70 SEGMENT 3 START
STA. 01+92 SEAM: MISALIGNED JOINTS, SEEPAGE PRESENT (~2 GAL./HR.), DRIPPING FROM CEILING
STA. 02+44 MINERALIZATION: IRON ALGAE/MINERALIZATION IN LOWER CORNERS, SURFACE WET BUT NO FLOW OBSERVED
STA. 02+70 SEGMENT 3 END

3 SECTION: DECANT CULVERT-SEGMENT 3

0 40 80 SCALE IN FEET

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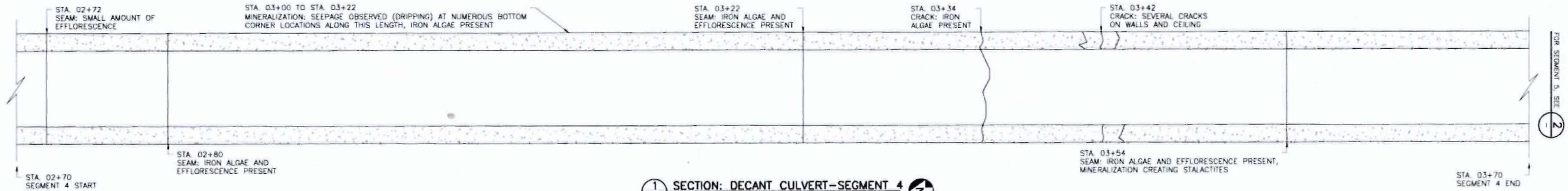
ST. LOUIS, MO

LEADWOOD DECANT TOWER INSPECTION
LEADWOOD, MO

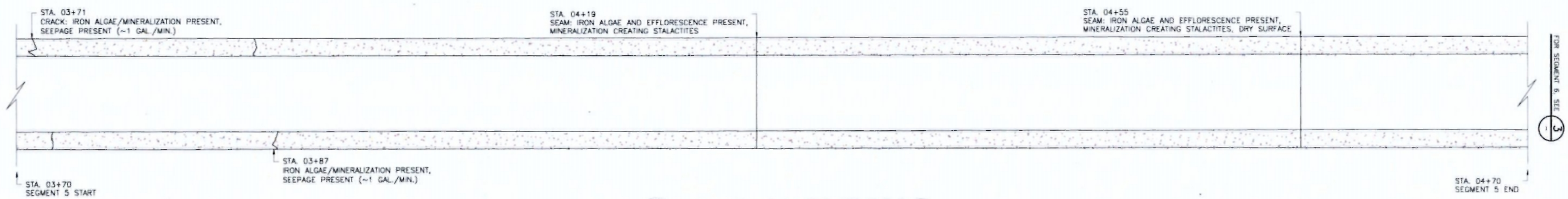
DECANT STRUCTURE
CULVERT DETAILS

BARR PROJECT No. 25861002.00
CLIENT PROJECT No.
DWG. No. C-04
REV. No. 0


STA. 02+72
SEAM: SMALL AMOUNT OF EFFLORESCENCE
STA. 03+00 TO STA. 03+22
MINERALIZATION: SEEPAGE OBSERVED (DRIPPING) AT NUMEROUS BOTTOM CORNER LOCATIONS ALONG THIS LENGTH, IRON ALGAE PRESENT
STA. 03+22
SEAM: IRON ALGAE AND EFFLORESCENCE PRESENT
STA. 03+34
CRACK: IRON ALGAE PRESENT
STA. 03+42
CRACK: SEVERAL CRACKS ON WALLS AND CEILING
FOR SEGMENT 5, SEE 2
STA. 02+80
SEAM: IRON ALGAE AND EFFLORESCENCE PRESENT
STA. 02+70
SEGMENT 4 START
STA. 03+54
SEAM: IRON ALGAE AND EFFLORESCENCE PRESENT, MINERALIZATION CREATING STALACTITES
STA. 03+70
SEGMENT 4 END

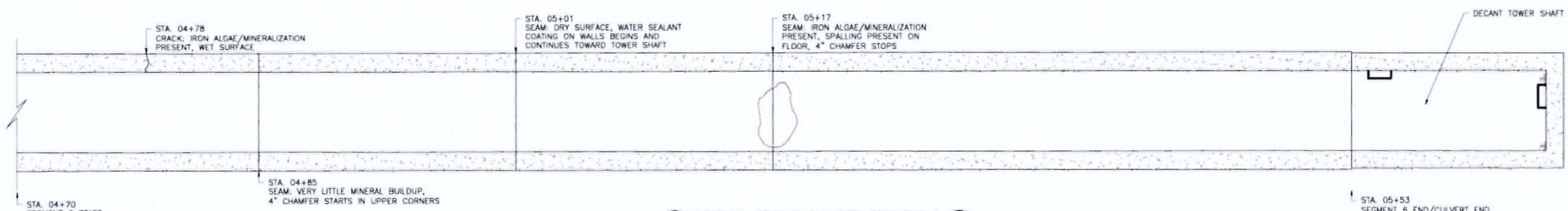
1 SECTION: DECANT CULVERT-SEGMENT 4 (C-04)

0 40 80 SCALE IN FEET


STA. 03+71
CRACK: IRON ALGAE/MINERALIZATION PRESENT, SEEPAGE PRESENT (~1 GAL./MIN.)
STA. 04+19
SEAM: IRON ALGAE AND EFFLORESCENCE PRESENT, MINERALIZATION CREATING STALACTITES
STA. 04+55
SEAM: IRON ALGAE AND EFFLORESCENCE PRESENT, MINERALIZATION CREATING STALACTITES, DRY SURFACE
FOR SEGMENT 6, SEE 3
STA. 03+87
IRON ALGAE/MINERALIZATION PRESENT, SEEPAGE PRESENT (~1 GAL./MIN.)
STA. 03+70
SEGMENT 5 START
STA. 04+70
SEGMENT 5 END

2 SECTION: DECANT CULVERT-SEGMENT 5

0 40 80 SCALE IN FEET


STA. 04+78
CRACK: IRON ALGAE/MINERALIZATION PRESENT, WET SURFACE
STA. 05+01
SEAM: DRY SURFACE, WATER SEALANT COATING ON WALLS BEGINS AND CONTINUES TOWARD TOWER SHAFT
STA. 05+17
SEAM: IRON ALGAE/MINERALIZATION PRESENT, SPALLING PRESENT ON FLOOR, 4" CHAMFER STOPS
DECANT TOWER SHAFT
STA. 04+85
SEAM: VERY LITTLE MINERAL BUILDUP, 4" CHAMFER STARTS IN UPPER CORNERS
STA. 04+70
SEGMENT 6 START
STA. 05+53
SEGMENT 6 END/CULVERT END

3 SECTION: DECANT CULVERT-SEGMENT 6

0 40 80 SCALE IN FEET

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